PATENT COOPERATION TREATY

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PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
19430PC DVA		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP 02/03239	21.03.2002	21.03.2002
International Patent Classification (IPC) or both national classification and IPC		
G11B7/0065		
Applicant		
DISCOVISION ASSOCIATES ET AL.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 4 sheets.

EPO - DG 1

26. 08. 2004

(37)

3. This report contains indications relating to the following items:

   I ☒ Basis of the opinion
   II ☐ Priority
   III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   IV ☐ Lack of unity of invention
   V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   VI ☐ Certain documents cited
   VII ☐ Certain defects in the international application
   VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
22.09.2003	23.07.2004
Name and mailing address of the international preliminary examining authority:	Authorized Officer
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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP 02/03239

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-15 as originally filed

Claims, Numbers

1-18 received on 07.07.2004 with letter of 02.07.2004

Drawings, Sheets

1/2-2/2 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☒ the claims, Nos.: 19,20

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-18
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-18
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-18
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1: US-A-3 560 072 (SILVERMAN DANIEL) 2 February 1971 (1971-02-02)

D3: US-A-5 696 613 (REDFIELD STEPHEN ROGER ET AL) 9 December 1997 (1997-12-09)

The document **D3** is regarded as being the closest prior art to the subject-matter of independent claims 1, 9, 13 and 17 and shows (the references in parentheses applying to this document):

1 Claim 1

a diffractive data storage system for recording data from a data source (computer) on diffractive optics memory (10), comprising:

a coherent light source (laser 12) split to form an object beam(data beam 100) and a corresponding reference beam (102), the object beam being modulated by the data by means of transmission through a display (SLM 108) encoding the data inputted by the data source in a two-dimensional pattern of transparent and opaque pixels (light and dark spots) and focused (by focusing system 110) on said memory following an optical axis perpendicular to a plane of said memory (optical axis between mirror 104 and medium 10)

a steering mirror (movable mirror 116) configured to direct said reference beam received from said coherent light source;

a first plurality of mirrors (128, 134) arranged around one side of said optical axis receiving said reference beam from said steering mirror (via mirror 122 when on the top position), said reference beam being directed at a corresponding first angle of a plurality of first angles towards said memory (by the movable mirror 116) ; and

a second plurality of mirrors (128', 134') arranged around the symmetrical side of said optical axis receiving said reference beam from said steering mirror (via mirror 122 when on the bottom position), said reference beam being directed at a second angle of a plurality of second angles towards said memory (by the movable mirror 116),

said first angle being identical in value to said second angle but formed on the symmetrical side of said optical axis;

(movable mirror 116 is directing the reference beam at different angles and mirror 122 is directing these beams on the two symmetrical sides of the optical axis)

said memory (10) comprising a plurality of points storing data therein, said object beam and said reference beam interfering at said first angle to form a first sub-hologram at one of said points of said memory and said reference beam interfering with said object beam at said second angle to form a second sub-hologram at said point (recording a plurality of interference patterns at the same location, a stack) and

said memory being mechanically shifted (by motive mechanisms 112 and 114) so that data are recorded at different points of said memory.

1.1 Difference

The subject-matter of claim 1 differs from this known D3 in that

each of said first plurality of mirrors directs said reference beam at a corresponding first angle of a plurality of first angles towards said memory; and

each of said second plurality of mirrors directs said reference beam at a second angle of a plurality of second angles towards said memory.

1.2 Art. 33(2) PCT

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

1.3 Problem(s) solved

The problems to be solved by claim 1 may be regarded as

(1)how to provide discrete and clearly separated paths of different angles for the reference beam and

(2)how to reduce the control effort.

1.4 Art. 33(3) PCT

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

D1 discloses a diffractive data storage system for recording data from a data source (subject 26, 26') on diffractive optics memory (film 30) by superimposing holograms on the same **area**

using an arrangement of fixed mirrors (55) that provide discrete and clearly separated paths of different angles for the reference beam (i.e solving the above problem) when individually addressed by the rotatable mirror 50.

Substituting the mirror 122 of D3 (in order to reduce the control effort since mirror 122 is controlled by motor 124 in the top and bottom positions) with the mirrors 55 of D1 is not considered to be a normal design option or a replacement of a feature by an equivalent feature since the relative arrangements of

the coherent light source;

the optical axis of the object beam;
the paths with different angles of the reference beam;
the medium;
the data source and
the steering mirror
are completely different in D3 and D1.

2 Claim 9

The argumentation for the system claim 1 holds mutatis mutandis for the method claim 9. The subject-matter of claim 9 is therefore new (Article 33(2) PCT) and involves an inventive step (Article 33(3) PCT).

3 Claim 13

D3 shows also (the references in parentheses applying to this document):

a diffractive data storage system for reading data from a diffractive optics memory (10) having a plurality of points, comprising:

a coherent light source (laser 12) forming a reference beam (102), an optical axis being defined by said reference beam being aligned perpendicular to a plane of said memory (part of optical axis between lenses 130 and 132 or 130' and 132');

a steering mirror (movable mirror 116) configured to direct said reference beam received from said coherent light source to said memory;

a first plurality of mirrors (128, 134) receiving said reference beam from said steering mirror and directing said reference beam at a corresponding first angle of a plurality of first angles towards one of said points of said memory;

a second plurality of mirrors (128', 134') receiving said reference beam from said steering mirror, directing said reference beam at a corresponding second angle of a plurality of second angles towards said one of said points of said memory;

said first angle being the same value as said second angle; and

an array of light sensitive elements (CCD detector array 42) configured to detect a first reconstruction beam of a first packet of data at said point of said memory illuminated with said reference beam and to detect a second reconstruction beam of a second packet of data at said point of said memory illuminated with said reference beam.

3.1 Difference

The subject-matter of claim 13 differs from this known D3 in that

the first plurality of mirrors is **arranged around one side of said optical axis, each of** said first plurality of mirrors directing said reference beam at a corresponding

first angle of a plurality of first angles towards one of said points of said memory;

the second plurality of mirrors is **arranged around the symmetrical side of said optical axis,**

each of said second plurality of mirrors directing said reference beam at a corresponding second angle of a plurality of second angles towards said one of said points of said memory,

said first and second angles **are formed on the symmetrical side of said optical axis.**

3.2 Art. 33(2) PCT

The subject-matter of claim 13 is therefore new (Article 33(2) PCT).

3.3 Problem(s) solved

The problems to be solved by claim 13 may be regarded as

(1)how to provide discrete and clearly separated paths of different angles for the reference beam and

(2)how to reduce the control effort

(3)how to improve reproduction

3.4 Art. 33(3) PCT

The solution to this problem proposed in claim 13 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

Substituting the mirror 122 of D3 (in order to reduce the control effort since mirror 122 is controlled by motor 124 in the top and bottom positions) with the mirrors 55 of D1 is not considered to be a normal design option or a replacement of a feature by an equivalent feature since the relative arrangements of

the coherent light source;

the optical axis of the reference beam;

the paths with different angles of the reference beam;

the medium;

the data source and

the steering mirror

are completely different in D3 and D1.

Furthermore, there is no hint in D1 that the mirrors 55 can arranged around an optical axis of the reference beam perpendicular to the medium (no part of the optical axis of the reference beam 23b is perpendicular to the medium).

4 Claim 17

The argumentation for the system claim 13 holds mutatis mutandis for the method claim 9. The subject-matter of claim 9 is therefore new (Article 33(2) PCT) and involves an inventive step (Article 33(3) PCT).

5 Claims 2-8, 10-12, 14-16 and 18

Claims 2-8 are dependent on claim 1;
claims 1-12 are dependent on claim 9;
claims 14-16 are dependent on claim 13; and
claim 18 is dependent on claim 17;
and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Nanos A.

CLAIMS

1. A diffractive data storage system for recording data from a data source on diffractive optics memory, comprising :

a coherent light source split to form an object beam and a corresponding reference beam, the object beam being modulated by the data by means of transmission through a display encoding the data inputted by the data source in a two-dimensional pattern of transparent and opaque pixels and focused on said memory following an optical axis perpendicular to a plane of said memory

a steering mirror configured to direct said reference beam received from said coherent light source ;

a first plurality of mirrors arranged around one side of said optical axis receiving said reference beam from said steering mirror, each of said first plurality of mirrors directing said reference beam at a corresponding first angle of a plurality of first angles towards said memory ; and

a second plurality of mirrors arranged around the symmetrical side of said optical axis receiving said reference beam from said steering mirror, each of said second plurality of mirrors directing said reference beam at a second angle of a plurality of second angles towards said memory, said first angle being identical in value to said second angle but formed on the symmetrical side of said optical axis ;

said memory comprising a plurality of points storing data therein, said object beam and said reference beam interfering at said first angle to form a first sub-hologram at one of said points of said memory and said reference beam interfering with said object beam at said second angle to form a second sub-hologram at said point, and

said memory being mechanically shifted so that data are recorded at different points of said memory.

2. The diffractive storage system of claim 1, wherein said memory comprises a polypeptide plate on which data is recorded.

3. The diffractive storage system of claim 1, wherein said steering mirror is a rotating mirror.

4. The diffractive storage system of claim 1, wherein said steering mirror is a Micro Opto Electro Mechanical System.

AMENDED SHEET

5. The diffractive storage system of claim 1, wherein the display is a spatial light modulator.

6. the diffractive storage system of claim 1, wherein the display is a liquid crystal light wave.

7. The diffractive storage system of claim 1, wherein said memory is made of a polypeptide material.

8. The diffractive storage system of claim 1 wherein the steering mirror is placed between said display and said memory

9. A diffractive storage method for recording data from a data source on a diffractive optics memory, comprising the steps of :

forming an object beam and a reference beam coherent with said object beam;

modulating the object beam by the data by means of transmission through a display encoding the data inputted by the data source in a two-dimensional pattern of transparent and opaque pixels and focusing the object beam on said memory following an optical axis perpendicular to a plane of said memory

directing said reference beam at a first angle of a first plurality of angles towards said memory by a corresponding one of a first plurality of mirrors arranged around one side of said optical axis ; and

directing said reference beam at a second angle of a second plurality of angles towards said memory by a corresponding one of a second plurality of mirrors arranged around the symmetrical side of said optical axis, said first angle being identical to said second angle but formed on the symmetrical side of said optical axis;

said memory comprising a plurality of points storing data therein, said object beam and said reference beam interfering at said first angle to form a first sub-hologram at one of points of said memory and said reference beam interfering with said object beam at said second angle to form a second sub-hologram at said point,

shifting said memory so that data are recorded at different points of said memory.

10 The diffractive storage method of claim 9, further comprising a MEOMS which directs said reference beam to one of said plurality of mirrors.

11. The diffractive storage method of claim 9, wherein said memory is made of a polypeptide material.

12. The diffractive storage method of claim 9, wherein said object beam has modulated thereon a plurality of pixels.

13. A diffractive data storage system for reading data from a diffractive optics memory having a plurality of points, comprising:

a coherent light source forming a reference beam, an optical axis being defined by said reference beam being aligned perpendicular to a plane of said memory;

a steering mirror configured to direct said reference beam received from said coherent light source to said memory;

a first plurality of mirrors arranged around one side of said optical axis receiving said reference beam from said steering mirror, each of said first plurality of mirrors directing said reference beam at a corresponding first angle of a plurality of first angles towards one of said points of said memory;

a second plurality of mirrors arranged around the symmetrical side of said optical axis receiving said reference beam from said steering mirror, each of said second plurality of mirrors directing said reference beam at a corresponding second angle of a plurality of second angles towards said one of said points of said memory, said first angle being the same value as said second angle but formed on the symmetrical side of said optical axis, and

an array of light sensitive elements configured to detect a first reconstruction beam of a first packet of data at said point of said memory illuminated with said reference beam and to detect a second reconstruction beam of a second packet of data at said point of said memory illuminated with said reference beam.

14. The diffractive storage system of claim 13, wherein said steering mirror is a Micro Opto Electro Mechanical System.

15. The diffractive storage system of claim 13, wherein said steering mirror is located on said optical axis directing said reference beam to one of said plurality of mirrors.

16. The diffractive storage system of claim 13, wherein said memory is made of a polypeptide material.

17. A diffractive data storage method for reading data from a diffractive optics memory, comprising the steps of:

directing a reference beam at a first angle of a first plurality of angles towards a first plurality of mirrors arranged around one side of an optical axis, said optical axis defined by said reference beam perpendicular to said memory;

reconstructing a first packet of information at a point of said memory with said reference beam;

detecting the first reconstructed packet with an array of light sensitive elements

directing said reference beam at a second angle of a second plurality of angles towards a second plurality of mirrors, said first angle being identical in value and symmetrical about said optical axis to said second angle;

reconstructing a second packet of information at said point of said memory with said reference beam, and

detecting the second reconstructed packet with an array of light sensitive elements.

18. The diffractive storage method of claim 17, wherein said memory is made of a polypeptide material.